



**CALIFORNIA
ENERGY COMMISSION**



California Energy Commission
Clean Transportation Program

FINAL PROJECT REPORT

Southern California Public Power Authority: DC Fast charger Installations

Local Travel, Local Fuel

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Technology Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to \$20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about \$100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-13-606 to provide funding opportunities under the Clean Transportation Program for electric vehicle charging infrastructure development. In response to PON-13-606, the recipient submitted an application, which was proposed for funding in the CEC's notice of proposed awards April 4, 2014 and the agreement was executed as ARV-13-038 on July 15, 2014 in the amount of \$500,000.

ABSTRACT

This report describes the results of the Southern California Public Power Authority's installation of 9 direct current fast chargers and 6, dual port, Level 2 alternating current chargers at 12 locations within the service territories of participating publicly owned utilities. The initial goal of the project was to install 9 fast chargers and 4 Level 2 units – but because the original purchase and installation costs were under budget, the Power Authority was able to gain authorization from the CEC to install 2 additional units to further support the opening of the Anaheim Regional Transit Center. All 15 of these installations served to increase electric vehicle charging infrastructure along major thoroughfares or corridors in southern California. Usage data was collected from the stations over a 23-month period ending October 31, 2016 to determine equivalent emission reductions and vehicle statistics.

Greenhouse gas emission reductions were based on the estimated number of electric vehicle miles traveled. The internal combustion engine miles displaced was determined by the measurement of energy delivered by the electric vehicle charging stations and the energy use per mile of an average electric vehicle. The estimated greenhouse gas emission reductions over the data collection period were almost 19 million metric tons of carbon dioxide equivalent emissions and it is estimated that over the 15 year life of the project the reductions will reach 300 million metric tons of carbon dioxide equivalent through eventual displacement of almost 1 million internal combustion engine vehicle miles.

Keywords: California Energy Commission, Electric Vehicle, Electric Vehicle Charging Stations, Greenhouse Gas Emissions, POU's, DC Fast Chargers, Level 2 Chargers

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EXECUTIVE SUMMARY

In January 2014, the Southern California Public Power Authority (SCPPA) submitted a grant application on behalf of Members and the City of Moreno Valley under the California Energy Commission's Program Opportunity Notice No. 13-606 as part of the ongoing Clean Transportation Program, also known as the Alternative and Renewable Fuel and Vehicle Transportation Program. The proposed program titled, "Local Travel, Local Fuel", was seen as an ideal fit to the Energy Commission's goals and objectives related to the enhancement of the electric vehicle charging infrastructure along the major highways or Corridors throughout the State.

Local Travel, Local Fuel initially proposed the installation of 9 Direct Current Fast Chargers and 4 dual port Level 2, Alternating Current (AC) chargers at 12 sites within the service territories of the participating publicly owned electric utilities. The estimated total budget for the project was slightly less than \$730,000; with SCPPA requesting the maximum award of \$500,000 with the Participants providing the balance of the budget as a match. Upon conclusion of the project, after acquiring the necessary amendment(s) to the Grant Agreement (ARV 13-038), SCPPA was able to install 9 DCFCs and 6 dual port Level 2 AC chargers at 12 locations – under budget.

SCPPA Staff and participating Members experienced many unexpected hurdles during the development and implementation phases of the project but they were all overcome and resolved in an appropriate time. These learning experiences were very useful and instructive for participants' continued expansion of existing electric vehicle charging equipment infrastructure.

The DCFCs and Level 2 chargers are a much-needed addition to the burgeoning electric vehicle charging infrastructure in the greater southern California region.

CHAPTER 1: Project Purpose

Southern California Public Power Authority

The Southern California Public Power Authority is a joint powers authority and a public entity organized under the California Joint Exercise of Power Act found in Chapter 5 of Division 7 of Title 1 of the Government Code of the State of California. Through the Joint Powers Agreement, SCPPA participates in planning, financing, developing, acquiring, constructing, operating and maintaining projects for the generation or transmission of electric energy in Southern California. SCPPA also facilitates joint service contracts, at the request of its Members, to aggregate like project efforts among its Members for the purposes of developing energy efficiency, demand response and resource procurement Programs or Projects to improve operating efficiencies and reduce costs.

Membership of SCPPA consists of eleven cities and one irrigation district, which supply electric energy within Southern California, including the municipal utilities of the cities of Anaheim, Azusa, Banning, Burbank, Cerritos, Colton, Glendale, Los Angeles, Pasadena, Riverside, and Vernon, and the Imperial Irrigation District. SCPPA is governed by its Board of Directors, which consists of representatives from each of its Members.

Goals and Objectives

In January 2014, SCPPA submitted a grant application on behalf of Members and the City of Moreno Valley under the California Energy Commission's Program Opportunity Notice No. 13-606 as part of the ongoing Clean Transportation Program, formerly known as the Alternative and Renewable Fuel and Vehicle Transportation Program. The proposed program titled, "Local Travel, Local Fuel", was seen as an ideal fit to the Energy Commission's goals and objectives related to the enhancement of the electric vehicle charging infrastructure along the major highways or Corridors throughout the State.

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Project Goals

The goals of the proposed project are consistent with the Program Opportunity Notice and include:

- Expand electric vehicle charging infrastructure to increase use of electric vehicles and reduce emissions associated with transportation by increasing destination charging and corridor charging.
- Successful installation and integration of DC Fast Chargers and Level 2 charging in POU Service territories.

- Support growth of electric vehicles as a conventional method of transportation by demonstrating the high level of use of new electric vehicle charging infrastructure.
- Data gathering, including kilowatt-hours (kWh) used, average charge duration, carbon dioxide equivalent (CO₂e) emissions avoided.

Project Objectives

The objectives of this project are to:

- Install DCFCs and Level 2 charging stations – to gain experience and knowledge for further expansions of utility-sponsored infrastructure
- Provide access to additional charging equipment for travelers into and out of member service territories
- Collect usage statistics for each station.

CHAPTER 2: Project Approach

Electric Vehicle Charging Equipment Procurement

The electric vehicle charging equipment that was installed under this project was obtained through a competitive Request for Proposal process. SCPA received 6 responses to the review process and were reviewed by the Evaluation Committee made up of participating Members. The respondent that was selected to provide equipment and installation services was Zeco Systems, Inc., dba Greenlots.

A primary consideration in selecting Greenlots was their highly competitive price for the Efacec QC50 DCFC¹ that operates at temperatures up to 122 degrees Fahrenheit and the multiple makes and models of Level 2 chargers that they offered. The performance of the DCFC at high temperatures was seen as critical to the Evacuation team and the wide selection of Level 2 models was important as well. A list of the equipment installed at each of the participating Members' sites is presented below:

- Anaheim Public Utilities
 - Efacec QC50 DCFC at Anaheim Regional Transit Center
 - 2- Eaton Dual Pedestal Units at Anaheim Regional Transit Center
- Azusa Light and Water - Efacec QC50 DCFC at Citrus Crossing Shopping Center
- Banning Electric Utility - Efacec QC50 DCFC at McDonalds restaurant
- Burbank Water and Power - Efacec QC50 DCFC at Lakeside Shopping Center
- City of Cerritos – 2 EVSE LLC Pedestal-mounted Dual units at Cerritos City Hall
- Colton Electric Utility
 - 1 EVSE LLC Pedestal-mounted Dual units at Arrowhead Medical Center
 - 1 EVSE LLC Pedestal-mounted Dual units at Fiesta Village Shopping Center
- Glendale Water and Power - Efacec QC50 DCFC at Glendale City Hall
- Los Angeles Department of Water and Power - Efacec QC50 DCFC at Dist. substation
- City of Moreno Valley - Efacec QC50 DCFC at Wal-Mart Store
- Pasadena Water and Power - Efacec QC50 DCFC at Metro Light Rail Station
- Riverside Public Utilities- Efacec QC50 DCFC at Riverside City Hall

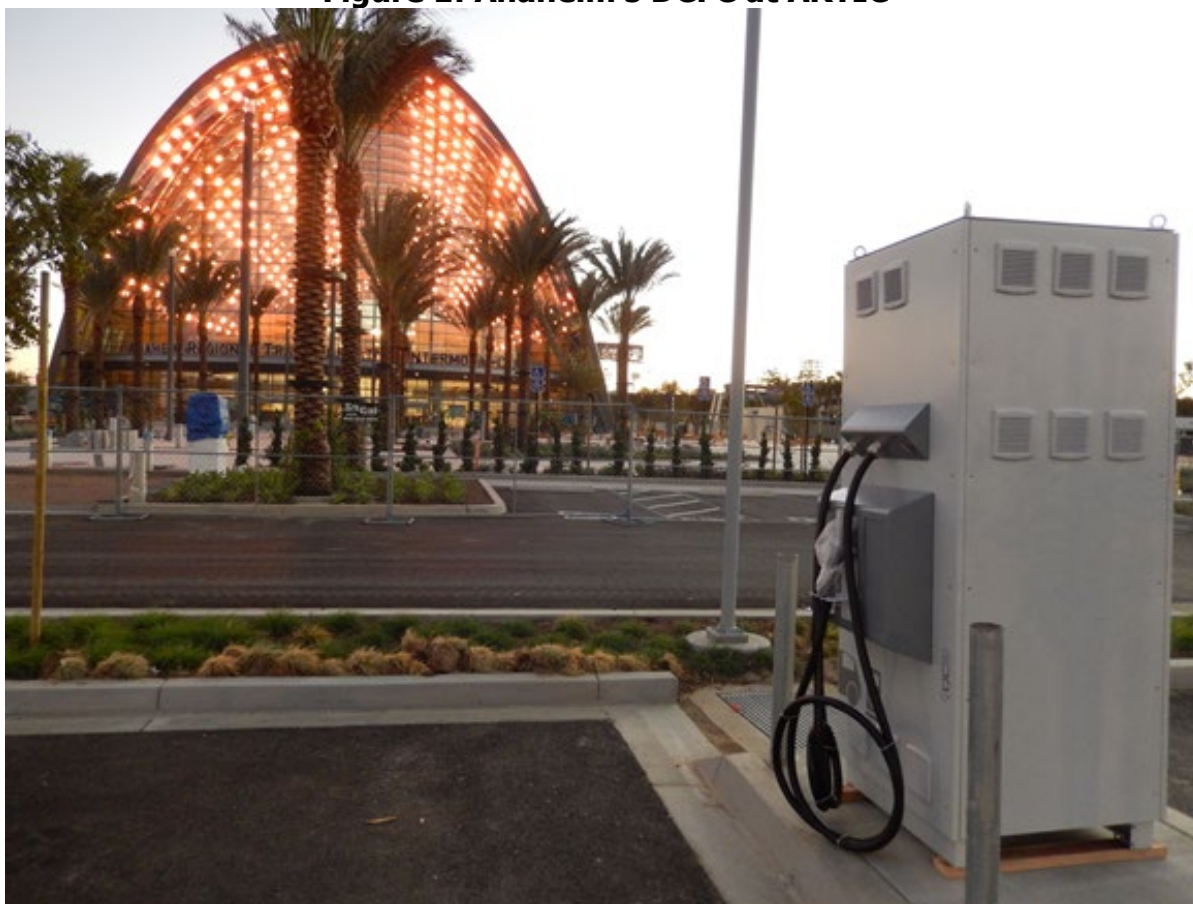
Electric Vehicle Charging Equipment Installation

The list above presents the full range and variance of the sites for each of the installations. Greenlots and their primary sub-contractor D'Alfonso Electric performed the primary installation at all of the sites, except for Banning. Banning Electric used their own line crews and M. Brey Electric as a subcontractor to perform certain functions.

¹ Efacec is a power engineering company based in Portugal with offices in the U.S. "QC 50" is the model number of their DC Fast Charger

Each installation involved challenges of varying degrees and setbacks. However, the installation team met each challenge and completed the work to the satisfaction of, SCPPA, the participating members and the site hosts. Figures 1-6 depict a few exemplary examples of the charging installations.

Figure 1: Anaheim's DCFC at ARTIC



Source: Anaheim Public Utilities

Figure 2: Azusa's DCFC at Citrus Crossing Shopping Center



Source: Azusa Light and Water

Figure 3: Banning's DCFC at McDonalds



Source: Banning Electric Utility

Figure 4: Colton's Level 2 Charger at Arrowhead Medical Center



Source: Colton Electric Utility

Figure 5: Colton's Level 2 Charger at Fiesta Village



Source: Colton Electric Utility

Figure 6: Glendale's DCFC at City Hall



Source: Glendale Water and Power

CHAPTER 3: Project Results

Data Collection Plan

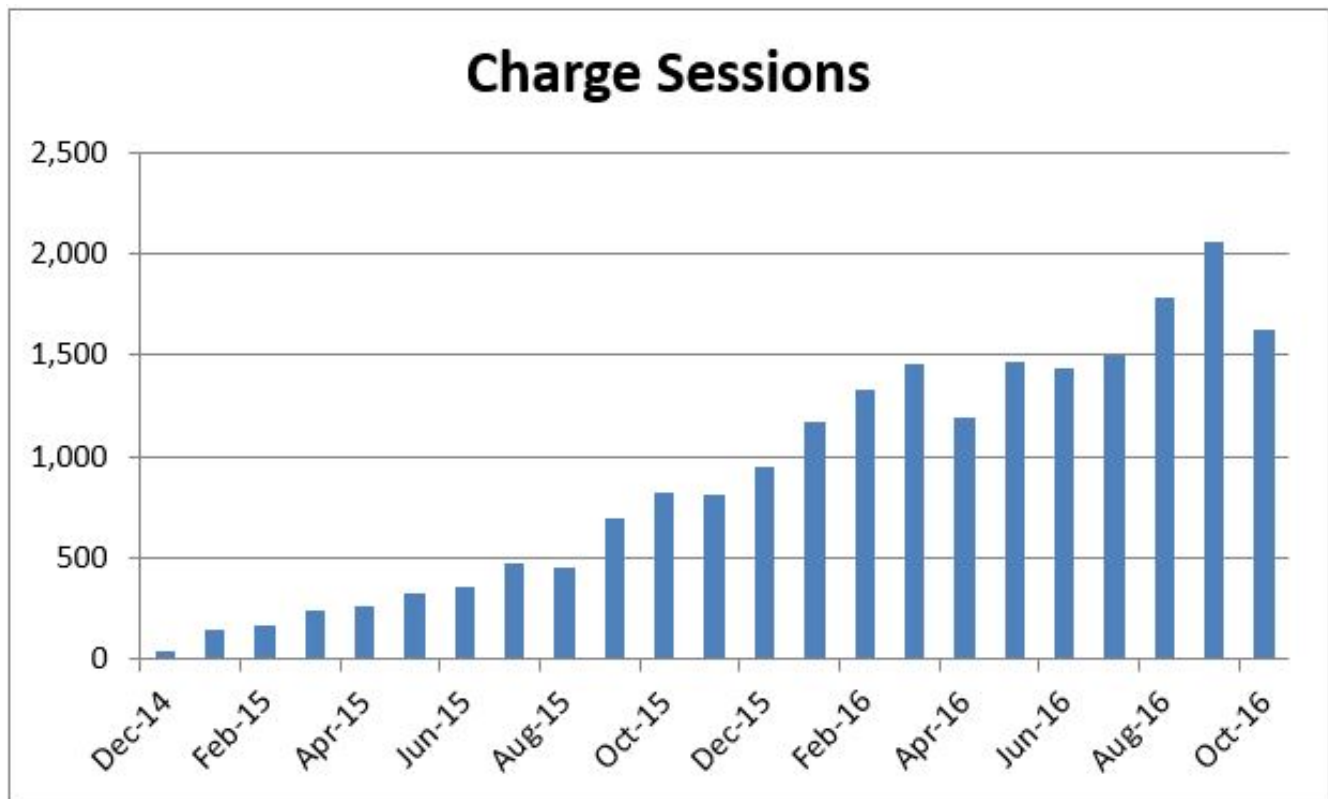
The Greenlots SKY network system allows for data collection of individual charging sessions such that data can be analyzed in a variety of ways. The focus has been on clean transportation fuel use to maximize reduction of carbon emissions and promotion of electric vehicle use. The analyzed metrics include:

- Number of charging sessions
- kWh used
- CO₂e emissions avoided
- Vehicle miles displaced

To obtain these metrics, Greenlots collected data from each stations' individual sessions including the date and duration of each session plus the kWh. The data was analyzed to determine totals for the 23-month period from December 2014 to October 2016.

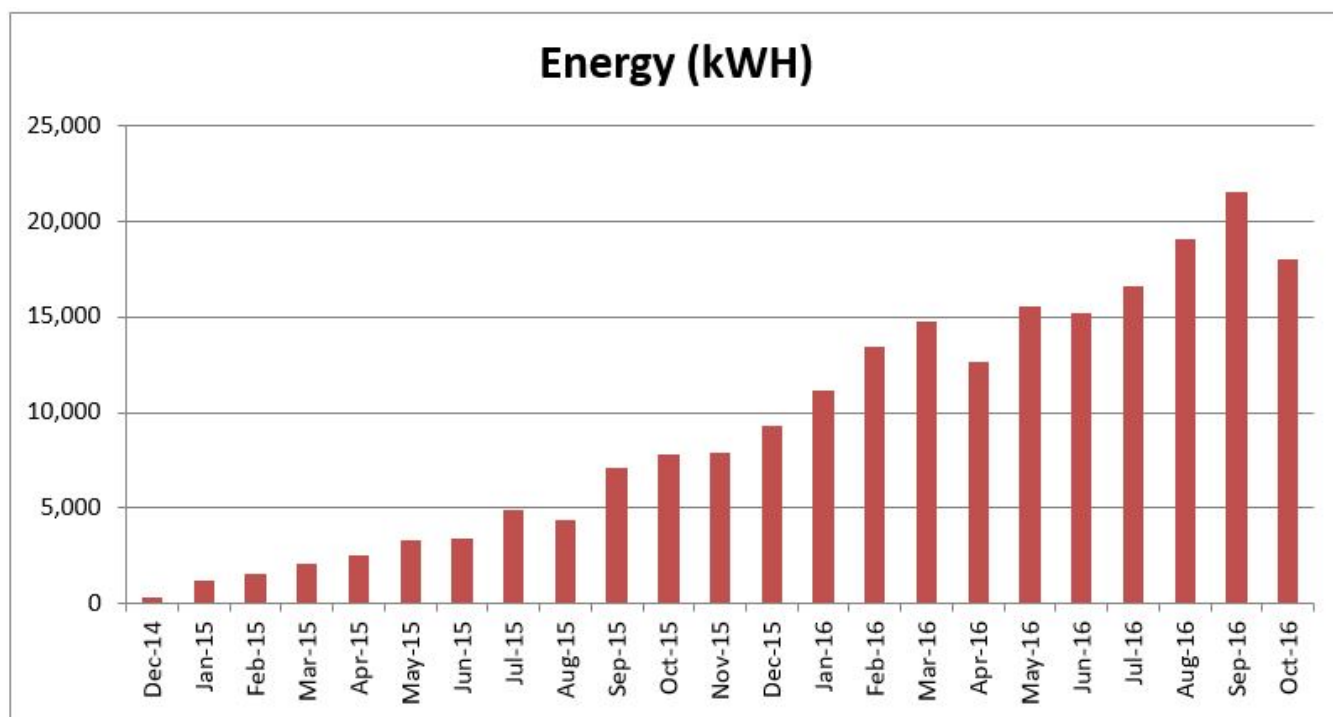
As expected and desired, the number of charging sessions has continued to grow, as has the number of kWh used by all of the stations combined, as shown below in Figures 7 and 8.

Figure 7: Monthly Number of Charging Sessions at SCPPA Sites



Source: Greenlots SKY Network and Southern California Public Power Authority

Figure 8: Monthly Energy (kWh) used at SCPPA Sites



Source: Greenlots SKY Network and Southern California Public Power Authority

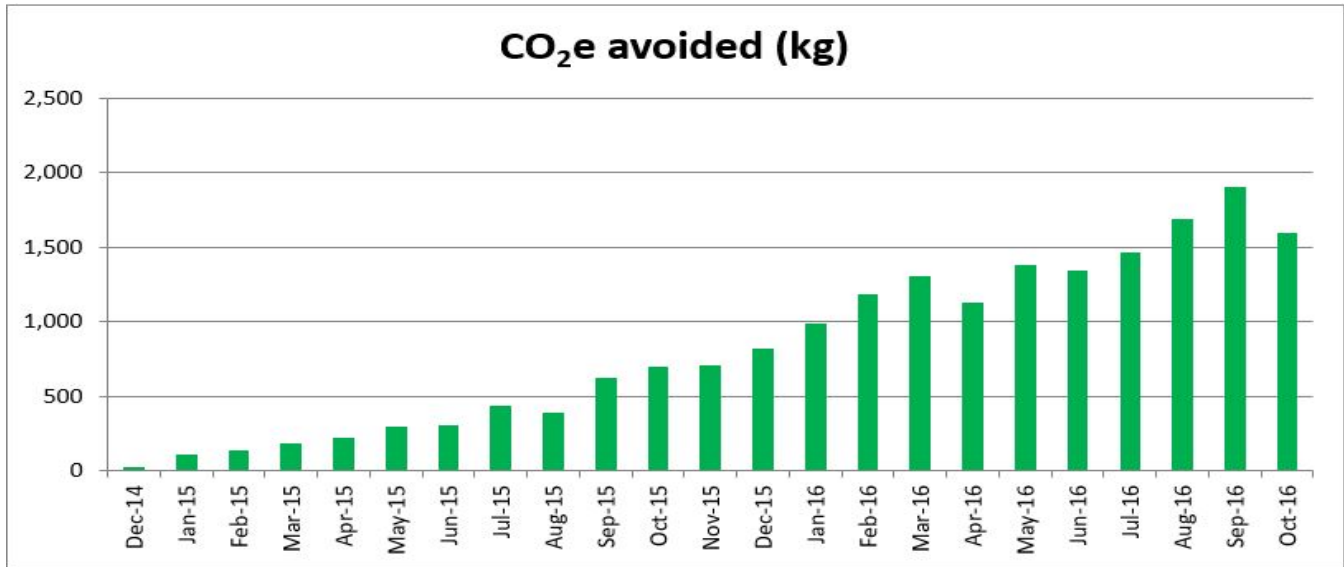
CO₂e Emissions Avoided

The overarching goal of this project was to increase the use of electric vehicles as a means to reduce the CO₂e emissions associated with light-duty vehicle transportation.

The Greenhouse Gas (GHG) emission reduction calculations herein are based on the number of electric vehicle miles traveled. In the case of the installed charging system, it was assumed that the internal combustion engine (ICE) miles displaced can be calculated by the energy used per mile of an average electric vehicle of 0.3 kWh per mile. According to the Union of Concerned Scientists, the California-Mexico Power Area region emits about 424 grams CO₂e per kWh for the average generation of electricity used. This does not take into account the time of usage and generation but will be fairly accurate in this case since charging takes place at all times of days and is not generally shifted towards nighttime charging when the electric generation mix may be different. Thus, for this analysis the generic electric vehicle will create emissions of 127.2 grams CO₂e per mile (424 grams CO₂e per kWh x 0.3 kWh per mile). Using the Environmental Protection Agency estimate of 423 grams CO₂e per mile (assuming 21 miles per gallon of gasoline consumed), the net GHG emissions reductions associated with this project was calculated to be 295.8 grams CO₂e per mile (88.74 grams/kWh) driven by the electric vehicles making use of the newly installed stations.

The monthly estimated GHG savings in kilograms CO₂e are shown below in Figure 9.

Figure 9: Monthly Estimated CO₂e emission Avoided by Charging Sessions at SCPPA Sites



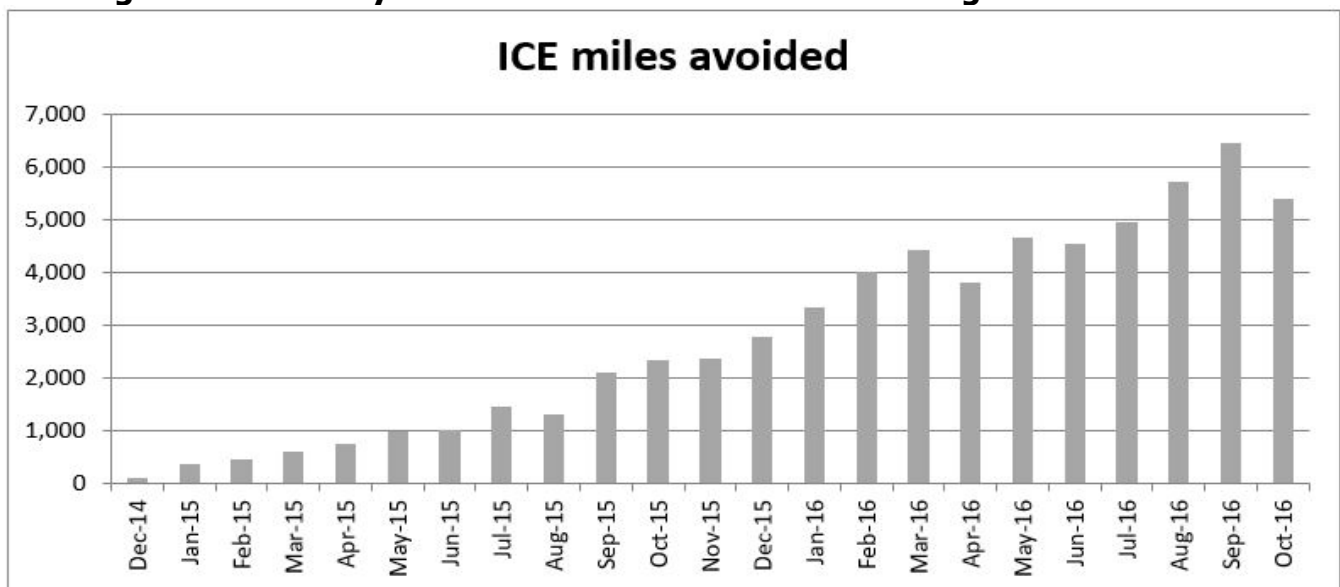
Source: Southern California Public Power Authority

The total emissions avoided over the current span of the project have been almost 19 million metric tons of CO₂e. With an estimated charger lifetime of 15 years, the combined total emissions avoided by the use of the chargers is expected to reach 300 million metric tons CO₂e.

Vehicle Miles Avoided

The ICE miles displaced by electric miles are calculated using the assumption of an average use of 0.3 kWh per mile. During the review period, more than 64,000 miles displaced were avoided or displace. The monthly results are shown in Figure 10 below.

Figure 10: Monthly Number of Internal Combustion Engine Miles Avoided



Source: Southern California Public Power AuthorityAC

Conclusion

SCPPA and our Members are pleased to have participated in the Energy Commission grant program under PON-13-606. The lessons learned regarding EV Charger site acquisition, equipment design, American Disabilities Act compliance, site restoration/beautification were very valuable for our Members' continued expansion of the charging infrastructure in their respective service territories. The 15 EV chargers that were installed under the grant program have provided prime access to charging in locations for customers of and visitors to our Members' cities.

The vehicle miles and CO₂e avoided or displaced through the use of the chargers is expected to grow substantially over the coming years as EV's become more main stream and SCPPA Members continue to endorse the widespread use of EV Charging.

GLOSSARY

ALTERNATING CURRENT (AC)—Flow of electricity that constantly changes direction between positive and negative sides. Almost all power produced by electric utilities in the United States moves in current that shifts direction at a rate of 60 times per second.

CARBON DIOXIDE EQUIVALENT (CO₂e) — A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.

Direct Current Fast Charger (DCFC) — Provides charging through 480 V AC input and requires highly specialized, high-powered equipment as well as special equipment in the vehicle itself.²

Greenhouse Gas GREENHOUSE GAS (GHG)—Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapor, carbon dioxide (CO₂), methane (CH₄), nitrous oxide (NO_x), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

INTERNAL COMBUSTION ENGINE (ICE)—The ignition and combustion of the fuel occurs within the engine itself. The engine then partially converts the energy from the combustion to work.

KILOWATT-HOUR (kWh)—The most commonly used unit of measure telling the amount of electricity consumed over time, means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumed 534 kWh in an average month.

SOUTHERN CALIFORNIA PUBLIC POWER AUTHORITY (SCPPA) — is a Joint Powers Authority, created in 1980, for the purpose of providing joint planning, financing, construction, and operation of transmission and generation projects. Comprised of eleven municipal utilities and one irrigation district, SCPPA's Members serve more than 5 million Californians (2 million customers) across a service area of 7,000 square miles. SCPPA's Members supply 16% of California's power.³

² [DC Fast Charger Definition](https://www.energy.gov/eere/electricvehicles/vehicle-charging) (https://www.energy.gov/eere/electricvehicles/vehicle-charging).

³ [SCPPA Homepage](http://scppa.org/) (http://scppa.org/).